

Docket. No.: 250507US-2 DIV
Inventor: Yoshiki IGARASHI, et al.

LISTING OF THE CLAIMS

Claims 1-17 (Canceled)

This listing of claims will replace all prior versions and listings of claims in the application.

Claim 18 (New): An oxide film etching apparatus comprising:

- a process chamber configured to maintain a vacuum environment;
- an upper and a lower electrode situated opposite to each other inside said process chamber, said lower electrode being configured to hold a target object having an oxide film formed on an upper surface thereof;
- a gas inlet configured to introduce an etching gas containing C_4F_6 gas and O_2 gas having a ratio of C_4F_6 gas to the O_2 gas within a range between 0.7 to 1.1 into the process chamber at a particular flow rate;
- power supply circuitry configured to supply power at different frequencies to the upper electrode and to the lower electrode to generate a high frequency field there between so as to generate a plasma in the etching gas introduced into the process chamber,
- wherein the oxide film of the target object is etched in the plasma generated by the high frequency field between the upper and lower electrodes in the process chamber.

Claim 19 (New): The apparatus according to Claim 18, wherein the particular flow rate is between 0.03 L/min to 0.1 L/min.

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Claim 20 (New): The apparatus according to Claim 19, wherein an inert gas consisting of Ar gas is introduced into the process chamber along with the etching gas.

Claim 21 (New): The apparatus according to Claim 20, wherein the pressure in the process chamber is between 1.33 Pa to 9.97 Pa.

Claim 22 (New): The apparatus according to Claim 21, wherein the residence time of the etching gas is between 0.69 msec to 5.6 msec.

Claim 23 (New): The apparatus according to Claim 18, wherein the frequency of the power applied to the upper electrode is within a range of 50 MHz to 80 MHz and the frequency of the power applied to the lower electrode is within a range of 1 MHz to 4 MHz.

Claim 24 (New): The apparatus according to Claim 18, wherein plasma density is between $5 \times 10^{10} \text{ cm}^{-3}$ to $2 \times 10^{11} \text{ cm}^{-3}$.

Claim 25 (New): The apparatus according to Claim 18, wherein target object temperature is maintained at a temperature at 100°C or higher during etching.

Claim 26 (New): The apparatus according to Claim 18, wherein the oxide film is a silicon oxide film and a silicon nitride film is formed under the silicon oxide film and the

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silicon oxide film is etched with an etching selectivity of 15 or more relative to the silicon nitride film.

Claim 27 (New) An etching apparatus for selectively etching an SiO₂ film relative to an SiN film on a target object, comprising:

a process chamber configured to maintain a vacuum environment;

an upper and a lower electrode situated opposite to each other inside said process chamber, said lower electrode being configured to hold the target object;

a gas inlet configured to introduce an etching gas consisting of C₄F₆ gas and O₂ gas into the process chamber at a particular flow rate;

power supply circuitry configured to supply power at a frequency between 50 MHz to 80 MHz to the upper electrode and power at a frequency between 1 MHz to 4 MHz to the lower electrode to generate a high frequency field there between so as to generate a plasma in the etching gas introduced into the process chamber,

wherein the SiO₂ film of the target object is etched in the plasma generated by the high frequency field between the upper and lower electrodes in the process chamber.

Claim 28 (New): The apparatus according to Claim 27, wherein the ratio of C₄F₆ gas to O₂ gas is between 0.7 to 1.1.

Claim 29. (New): The apparatus according to Claim 28, wherein the particular flow rate is 0.03 L/min to 0.1 L/min.

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Claim 30 (New): The apparatus according to Claim 29, wherein an inert gas consisting of Ar gas is introduced into the process chamber along with the etching gas.

Claim 31 (New): The apparatus according to Claim 30, wherein the pressure in the process chamber is 1.33 Pa to 9.97 Pa.

Claim 32 (New): The apparatus according to Claim 31, wherein a residence time of the etching gas is 0.69 msec to 5.6 msec.

Claim 33 (New): The apparatus according to Claim 27, wherein the plasma has a density of $5 \times 10^{10} \text{ cm}^{-3}$ to $2 \times 10^{11} \text{ cm}^{-3}$.

Claim 34 (New): The apparatus according to Claim 27, wherein target object temperature is maintained at a temperature at 100°C or higher during etching.

Claim 35 (New): The apparatus according to Claim 27, wherein the SiO₂ film is etched with an etching selectivity of 15 or more relative to the SiN film.

Claim 36 (New): An etching apparatus for selectively etching an SiO₂ film relative to SiN film on a target object, comprising:

a process chamber configured to maintain a vacuum environment;

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an upper and a lower electrode situated opposite to each other inside said process chamber, said lower electrode being configured to hold the target object;

a gas inlet configured to introduce an etching gas consisting of C_4F_6 gas and O_2 gas and an inert gas consisting of Ar gas into the process chamber at a particular flow rate;

power supply circuitry configured to supply power at different frequencies to the upper electrode and to the lower electrode to generate a high frequency field there between so as to generate a plasma in the etching gas introduced into the process chamber,

wherein the SiO_2 film of the target object is etched in the plasma generated by the high frequency field between the upper and lower electrodes in the process chamber.

Claim 37 (New): The apparatus according to Claim 36, wherein the ratio of C_4F_6 gas to O_2 gas in the etching gas is between 0.7 to 1.1.

Claim 38 (New): The apparatus according to Claim 37, wherein the particular flow rate is 0.03 L/min to 0.1 L/min.

Claim 39 (New): The apparatus according to Claim 38, wherein the pressure in the process chamber is 1.33 Pa to 9.97 Pa.

Claim 40 (New): The apparatus according to Claim 39, wherein a residence time of the etching gas is 0.69 msec to 5.6 msec.

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Claim 41 (New): The apparatus according to Claim 36, wherein power of a frequency of 50 MHz to 80 MHz is applied to the upper electrode and power of a frequency of 1 MHz to 4 MHz is applied to the lower electrode.

Claim 42 (New): The apparatus according to Claim 36, wherein plasma density is between $5 \times 10^{10} \text{ cm}^{-3}$ to $2 \times 10^{11} \text{ cm}^{-3}$.

Claim 43 (New): The apparatus according to Claim 36, wherein target object temperature is maintained at a temperature at 100°C or higher during etching.

Claim 44 (New): The apparatus according to Claim 36, wherein the SiO_2 film is etched with an etching selectivity of 15 or more relative to the SiN film.